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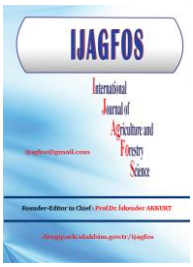

Review Article

Greenhouse Production in Bilecik[#]

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Abstract: Bilecik is located at the intersection of the eastern Marmara, the northern Aegean, the western Black Sea and the Central Anatolia region in Turkey. This section is known as gateway section in which different climate conditions exist. There is a wide range of plant population in this section. Besides, Bilecik has a great chance on agricultural production, if these advantages are correctly harnessed. Greenhouses are used for delivering the production during all year around. Geographic location, plant species diversity, proximity to Istanbul, the increase of the greenhouse will raise the importance of Bilecik. The data about the greenhouse area, greenhouse types, the distribution of greenhouses to county, product pattern and multi-year climate data (monthly number of sunny days, minimum and maximum temperature, mean temperature) in Bilecik are reviewed. The success of a greenhouse depends on many factors. It is difficult to guess the means for developing the potential of the greenhouse in Bilecik. The aim of this study is presenting the relevant data about greenhouses and reviewing the actual status of greenhouses in Bilecik.

1. Introduction

Allowing to gain maximum yield from small areas by procuring higher profits from unit area, green-house production has now become one of the most significant agricultural activities of Turkey also by virtue of providing regular laborforce use throughout the year [7].

Green-house agriculture integrates production phase under greenhouse or low plastic tunnels. Low plastic tunnels are the structures that are procured by covering the surface of circa 60 cm radius and semicircle-sectioned frames laid over vegetation rows with soft and plastic covers [7]. (Earliness is aimed in this plant production performed below low plastic tunnels. Greenhouses are the kind of structures that can, when climate conditions are unfavorable for open-air vegetative production, provide means for cost-effective growth of cultivated plants and ensure the vital factors for plant production and it is also feasible to walk inside these structures [2,3].

Globally greenhouse-owner countries were separated into two zones after 1970-dated energy crisis. Countries located in northern climate zone selected to produce in climate-controlled greenhouses whereas countries in southern climate zone, including Turkey, production became essentially a dependent variable of ecological conditions.

In its broader context, greenhouses can be delineated as the facilities in which, when weather conditions are unfavorable, specific plants and flowers can be produced cost-effectively. This business is termed as "greenhouse cultivation". 'When weather conditions are unfavorable' is a reference indicative of fall, winter and spring seasons when weather temperature is relatively low. Inside greenhouses or more generically in green-house production, aside from temperature, factors such as humidity, light and air could also be controlled to procure higher-quality

and quantity of plants. As is the case in the agricultural regions within Turkey, in Bilecik region likewise, the core reason accounting for the migration from rural areas is lack of sizable lands and high capital [10].

As a result of rising population and consequential disputes in inheritance, lands have been torn into small pieces in Turkey. Thus there is a parallel decrease in agricultural production, which necessitates maximum use of unit area. Presently greenhouse business emerges as a major factor in extending the occupancy period of labor force in rural parts and as an outcome of the increment in the business of producers, greenhouse activities enable further profits. Besides, although being vital nutrients for human health, it is not feasible to grow fresh vegetables all year around in open plantations. The vitality of fresh vegetables stems from the vitamins, hormones, bases, minerals and bio-chemicals contained (Yüksel, 2000). To overcome this bottleneck in vegetable production and offer fresh vegetable products to the consumers it becomes even more critical to grow vegetables in certain structures equipped with favorable environmental conditions, such as greenhouses [10].

2. Material

2.1 Geographical Position of Bilecik City

Bilecik is positioned within 39° 39' - 40° 31' northern latitudes and 29°43' - 30°41' eastern longitudes. Situated at the intersection point of Marmara, Black Sea, Central Anatolia and Aegean Regions Bilecik occupies 4307 km² acreage and ranks 65th in the list of all cities. Bilecik is a largely-rugged terrain, split by steep and deep valleys, partly covered by erosion plateaus. City center is 500 meters above sea level. In terms of height not any significant differences exist among districts [9]. This elevation difference is likely to range from 150 meters to 1850 meters.

2.2 Topography

The city has quite a rugged topography which is split by steep and deep valleys, partly covered by erosion plateaus and slopes. 32% of the total land is covered by mountains, 8% covered by plains and 60% covered by formations such as flatland, plateaus and slopes [9].

2.3 Climatic Features

With respect to agro-ecological features Bilecik is grouped into two subregions. In the first subregion consisting of Center, Söğüt, Osmaneli and İnhisar dominant climate type is Marmara and Mediterranean but in the second subregion consisting of Bozüyük, Gölpazarı, Pazaryeri and Yenipazar districts dominant climate type is continental (Figure 1).

Bilecik is positioned in the southeast of Marmara Region at the intersection point of Marmara, Black Sea, Central Anatolia and Aegean Regions. Being at the intersection point of these regions, the city exhibits three different climate types [9].

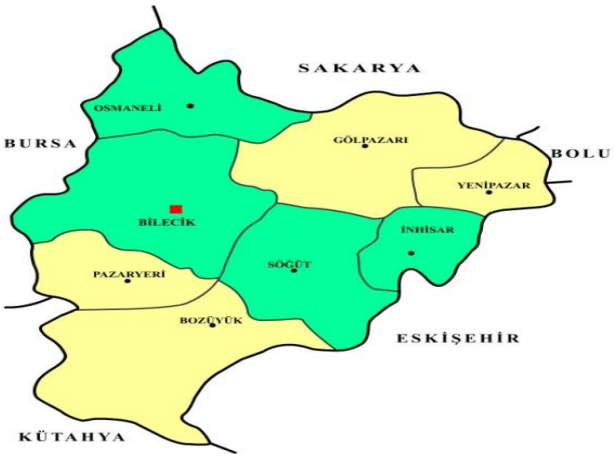

Figure 1. *Bilecik subclimate regions*

In Bilecik city, total precipitation per year is circa 450 mm. The heaviest amount of rainfalls is measured in December, January and February (Table 1). These values are measured in city center so changeable in districts. An analogous discrepancy can also be measured between different years.

Overall speaking, once we observe city center, Osmaneli, Söğüt and Yenipazar districts in the 1st subclimate zone of Bilecik, we can detect that during winter season monthly temperature mean values are below zero for only a short length of time (Table 2). This is a favorable condition for temperature factor which is one of the vital components in green-house business and proves that the region is fit for green-house production. High number of sunny days per year is another favorable condition for green-house production.

2.4 Definition of Greenhouse

Green-house production is an extensive term; however it can be defined as, via partially or completely eliminating the negative effects of environmental conditions, producing plants in a variety of greenhouses depending on the modernity and advancement of vegetative production equipments.

In greenhouse systems the objective is to create an outer environment for all plants that are protected from outside weather conditions and to prepare a more favorable environment. However it is not feasible to build the same greenhouse systems in all regions. For instance, in microclimatic regions, it is not an effective method to build a sizable greenhouse system. In regions such as Bilecik where microclimatic conditions dominate, due to the failure to find required height levels and floor areas, it is not simple to identify places with larger square meters. Besides in simple greenhouse structures with lower height and plain construction, inclusion of ventilation to greenhouse construction triggers an extra increase in total cost. Thus in lieu of advanced greenhouse system it becomes mandatory to pot for simple greenhouse types. Due to the reasons listed above, it may be suggested to review the definition of greenhouses in particular for microclimatic regions.

Consequently, irrespective of being a microclimatic region or not, greenhouse systems could be at best categorized under 3 groups as below.

a- Basic Greenhouse (BG) (Greenhouse)

- **Panel covers:** In green-house production mulching and panel covers are cushion-shaped systems covering the top of plants for short-long lengths. Also all agricultural procedures are externally operated.

- **Low tunnels**: 1 meter above the ground level these covers are removed when the temperature rises and plants reach to a certain height. Also all agricultural procedures are externally operated outside the cover.

b- Simple Greenhouse

- **High Tunnels**: Narrow and semicircle-sectioned structures in green-house production. People can easily enter into these tunnels that allow agricultural mechanism, but tunnels lack heating and ventilation systems. These high tunnels are among the best adaptive greenhouse types in terms of efficiency and cost to better suit microclimatic Bilecik region Sakarya basin.

However noting the fact that in these simple greenhouses of which height is limited with 3 meters and also the warm weather conditions in microclimatic regions, the crops could be affected adversely. To protect the crops it is suggested to integrate ventilation equipments and rise the height of greenhouses to 4,5 – 5 meters. Hence it would be more appropriate to analyze this group under two sub- categories as ventilated and non-ventilated simple greenhouses.

c- Advanced Greenhouse (AG) (Greenhouse)

During the periods when climatic conditions are not favorable for open-air plant production, these advanced structures allow to grow cultivated plants in low-costs; procure the required growth factors for vegetative production and help in conducting mobile farming inside the structure.

These advanced-form greenhouses are generically defined as structures in which, independent of climate-borne environmental conditions, it is feasible to produce fresh vegetables and plants at low cost all year around [7].

According to the greenhouse standards issued by Turkish Standards Institute on the other hand, greenhouse and greenhouse business refer to; without totally or partially depending on climatic environmental conditions, and if need arises; by controlling factors viz. temperature, humidity, light and air conditioning; in order to produce different cultivated plants and seeds, seedlings and saplings of such plants all- yearlong; to preserve and exhibit the plants by coating with glass, plastic or similar opaque materials it is a high-system green-house production structure built in various formats [7]. According to the definition provided by Turkish Standards Institute, in regions such as Bilecik Sakarya basin, top-covered structures in which agricultural activities take place do not match with this description since as we noted in defining a greenhouse, it is infeasible to attain large areas in

these regions. Even if they could be found, these greenhouses are not effective for use. It would be more practical to build greenhouses with smaller square meters and in a level of height allowing tractor entrance. Definition in TSI includes structures in which factors such as height, temperature, humidity, light and ventilation are controlled. However, unlike cold climates that require ventilation rather than warmth, warm climate greenhouses are added in the definition of microclimatic greenhouses.

3. Method

3.1 Significance of Greenhouse Business

In order to adequately nourish the rising population in Turkey and to achieve a high income level, production must be magnified. This can be possible by the coordinated development between industrialization and agricultural sector. In modern age increased depletion and pollution in land, air and water resources leads to a parallel decrease in arable lands. Consequentially, unhealthy and low-quality production escalate. Furthermore, increased demand of global markets for food items forcefully pushes our production motives to foreign markets. It is thus imperative to take certain measures so as to multiply and refine agricultural production. One of these measures is greenhouse business since climate conditions in Turkey enable a continuous and quality production [7].

One of the basic characteristics of agricultural production is that it is denser in specific seasons. That feature disallows year-long attainability of any given product. Greenhouse business or in other terms greenhouse vegetable and fruit production nullifies this condition thereby enabling a myriad of products to be marketed continuously. In addition, greenhouse production assists the producers to gain high profits from the products that they market off the season [8].

Table 1: *Years-extending mean values observed in Bilecik city (1960 – 2016).*

BILECIK	January	February	March	April	May	June	July	August	September	October	November	December
Mean Temperature (°C)	2.6	3.7	6.6	11.5	16.1	19.9	22.1	22.0	18.4	13.8	9.0	4.7
Mean Maximum Temperature (°C)	6.0	7.8	11.5	16.9	21.9	25.8	28.4	28.6	24.9	19.3	13.5	8.1
Mean Minimum Temperature (°C)	-0.3	0.3	2.5	6.7	10.8	14.1	16.2	16.4	13.1	9.5	5.5	1.9
Mean Sunny Period (hour)	3.2	3.5	4.5	6.1	8.1	9.4	10.3	10.0	8.2	5.5	4.2	3.1
Mean Number of Rainy days	14.2	13.2	13.0	11.3	10.3	7.8	4.2	3.4	5.2	8.5	9.9	13.2
Mean Value of Monthly Total Rainfall (kg/m^2)	49.9	42.3	47.0	43.3	47.5	39.4	18.9	11.3	21.1	41.6	37.7	54.5

Table 2: *Meteorological features of Bilecik Center, Osmaneli, Söğüt and Gölpazarı districts.*

BİLECİK CENTER	MONTHS													
	Observation Period (year)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yıllık
Mean high temperature (°C)	56	5,7	7,2	11,4	16,4	21,5	25,3	27,6	27,7	24,2	18,9	13,5	7,9	17,3
Mean low temperature (°C)	56	-0,4	0,3	2,3	6,2	10,7	13,9	15,5	15,8	12,7	9,3	5,6	1,8	7,8
Mean monthly temperature (°C)	56	2,6	3,8	6,4	11,1	15,9	19,6	24,6	21,5	18	13,6	9	4,5	12,3
Mean number of sunny days (0.0-8.0)	56	16,3	15,2	18,1	21,4	25	27,6	29,8	29,9	27,4	24,4	20,4	18	273,5

OSMANELİ	MONTHS													
	Observation Period (year)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yıllık
Mean high temperature (°C)	5	8,9	11,7	15	18,6	24,8	29,4	32,2	32,4	28,6	21	14,8	10	20,6
Mean low temperature (°C)	5	-0,3	0,7	1,9	7	10,2	14,1	16,9	15,9	12,2	8,5	4	1,7	7,7
Mean monthly temperature (°C)	5	4	5,9	8,4	14,4	17,6	22,5	25,2	24,7	20,9	14,6	8,9	5,5	14,4
Mean number of sunny days (0.0-8.0)	21	17,1	15,8	19	19,9	24,7	27,2	29,5	28,5	27,4	23,3	19,7	17,8	271,2

SÖĞÜT	MONTHS													
	Observation Period (year)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yıllık
Mean high temperature (°C)	25	5,7	7,7	12,5	17,2	21,8	25,6	28	28	24,9	19	13,2	7,9	17,6
Mean low temperature (°C)	25	-1	0	2,2	6,4	9,6	12,6	14,6	14,2	11,5	7,9	4,4	1	7
Mean monthly temperature (°C)	25	1,9	3,4	6,3	11,5	15,6	19,2	21,2	20,5	17,6	12,8	8,3	4	11,9
Mean number of sunny days (0.0-8.0)	25	22,8	20,8	22,6	23,3	26,4	28,7	30	30,8	29,4	26	23,8	23,6	308,1

YENİPAZAR	MONTHS													
	Observation Period (year)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yıllık
Mean high temperature (°C)	3	7	9	14,2	19,7	21,8	20,7	29,2	30,2	25,1	18,6	13,2	8,8	18,1
Mean low temperature (°C)	3	-6,7	-3,8	-1,2	3,9	6	9,1	11,9	10,6	6,5	3,7	0,7	-1,9	3,3

Mean monthly temperature (°C)	3	-0,7	2,1	6	12	14,5	18,4	12,3	20,8	15,7	10,7	6,6	3,2	10,9
Mean number of sunny days (0.0-8.0)	24	13,7	13,4	15,8	17,8	22,7	26,3	28,7	29	27,3	22,4	17,9	15,1	250,2

Adding to all the factors above, greenhouse production is a salient branch of agriculture by virtue of the export value it creates and also the employment opportunities it renders. Although greenhouse production is a lucrative activity since greenhouse products are denser in off the season times when cannot be grown naturally on the farm, it is a production domain that demands further knowledge and capital since greenhouse production is costly and based on technical know-how [8].

As we analyze the statistics of the last 7 years we can see an overall rise in Turkish greenhouse production areas and in 2012, compared to year 2005, the figures increased approximately 1,5 time (Table 4). As for the greenhouse production area in Bilecik, in 2012, compared to year 2005, the figures increased exactly 4 times. The major part of Bilecik green-house production is formed by plastic greenhouses.

3.2 Current Position of Greenhouse Business and Green-house Production in Turkey

- In Turkey about 27 million tons of raw vegetable is produced per year
- Of the total of 6,1 million tons of green-house production, vegetable group constitutes 5,9 million tons.
- Our total green-house assets equate to 649.000 decares and 380.000 da (58%) is composed of high systems.
- With respect to green-house assets Turkey is among the top four countries in global list and shares the first rank with Spain in Europe list.
- For the last decade average green-house business size increased from 2 decares level to 4 decares in Turkey.
- Turkey's green-house vegetative production values exceeded 3 billion USD.
- Antalya, with its 51% share (3,2 million tons), ranks the first in Turkey's green-house production list.
- Antalya is respectively followed in the list by Mersin 18% (1 million ton), Adana 11% (670 thousand tons) and Muğla 9% (527 thousand tons) (Table 3).
- Total green-house production ratio measured in 4 cities is approximately 5,4 million tons, hence equating to circa 90% of total green-house production ratio.

Top 10 cities as per total production area are as seen in Table 3.

Spanning over a total land of 78 million ha, cultivated agricultural area in Turkey holds a 31% share (24.437.000 ha) in the total area. In this total land, 67% of land is reserved for field crops, 16% for garden plants and 17% for fallowing purposes. Because Turkey exhibits a variety of ecological

Table 3: *Top 10 cities as per production area*

CITY	PRODUCTION AREA (Thousand decare)
1.Antalya	258
2.Mersin	162
3.Adana	96
4.Muğla	38
5.Samsun	22
6.İzmir	15
7.Aydın	13
8.Hatay	10
9.Bilecik	3
10.Kocaeli	2

Source: TÜİK 2015 (Turkish Institute of Statistics)

conditions it provides a favorable environment to produce different types of garden plants. Greenhouse production also shares a significant position in this group. In Turkey, greenhouse production includes production in greenhouses and plastic tunnels. As of 2010, our total area of greenhouses is over 56 thousand ha. In

Table 4: *Greenhouse Agricultural Areas (da) as per Quality*

		Total	Glass greenhouse	Plastic greenhouse	High tunnel	Low tunnel
Turkey	2005	467 540	65 427	171 043	66 916	164 154
	2006	469 081	68 353	182 354	69 834	148 540
	2007	494 239	75 793	195 180	65 307	157 959
	2008	542 158	82 253	211 680	66 960	181 265
	2009	567 180	82 932	220 186	77 046	187 016
	2010	563 805	80 772	230 543	81 521	170 969
	2011	611 450	78 878	247 962	108 910	175 701
	2012	617 760	80 728	278 730	95 095	163 207
	2013	615 000	81 000	279 000	98 000	157 000
	2014	649 000	81 000	29 900	112 000	157 000
	2015	663 621	79 976	309 429	112 673	161 540
Bursa Eskişehir Bilecik	2005	1532	-	968	114	450
	2006	1607	-	1228	379	-
	2007	1562	-	1117	416	29
	2008	2 407	-	1 764	624	19
	2009	2 888	-	2 238	634	16
	2010	3 720	-	2 698	1 022	-
	2011	4 442	5	3 296	1 139	2
	2012	5 693	18	4 174	1 497	3
	2013	7074	21	5 433	1 615	3
	2014	7 704	5	5 897	1 797	4
	2015	7 405	4	5 436	1 964	-
Bilecik	2005	616	-	533	73	10
	2006	776	-	647	129	-
	2007	960	-	821	129	10
	2008	1 357	-	1 228	129	-
	2009	1 873	-	1 634	239	-
	2010	2 270	-	1 996	274	-
	2011	2 339	-	2 051	288	-
	2012	2 603	-	2 240	363	-
	2013	3 455	-	3 090	365	-
	2014	3 593	-	3 093	500	-
	2015	3 558	-	2 915	643	-

Table 5: *District-based Distribution of Greenhouse Production in Bilecik*

Districts	Number of Villages	Number of Businesses	Total Plastic Greenhouse (da)	Total High Tunnel (da)
Center	5	24	68	-
Bozüyük	-	-	-	-
Gölpazarı	1	8	42	-
İnhisar	6	55	-	500
Söğüt	7	470	2800	-
Osmaneli	22	140	-	140
Pazaryeri	3	6	5	-
Yenipazar	3	3	-	3
Total	**47**	**706**	**2915**	**643**

Source: TUIK (Turkish Institute of Statistics) and İVA Statistics 2015

Table 6: *Distribution of Cultivated Agricultural Areas in Bilecik*

Type of Agricultural Area	Area (Da)	% Distribution
Field Crop Cultivation Area	523.915	38
Vegetable Area	64.048	4.6
Greenhouse Vegetable Area	3.558	0.25
Fruit Area	100.734	7.3
Vineyard Area	13.108	0.9
Fallowing Area	123.302	9
Poplar Area	162.876	11.95
Cabbage (keleme) Area	390.449	28
Total	1.381.990	100

Source: TUIK (Turkish Institute of Statistics) and İVA Statistics 2015

Table 7: *Distribution of Bilecik Agricultural (Cultivated) Areas (da)as per districts*

Districts	Total area (Da)	Area for Grains and Other Crops(Da)	Fallowing area (Da)	Area for Vegetable Gardens (Da)	Area for fruits, drink plants and spices (Da)
Center	135.563	92.924	18.091	13.133	11.415
Bozüyük	165.624	118.258	42.439	1.999	2.928
Gölpazarı	102.120	64.317	575	9.146	28.082
İnhisar	25.469	9.546	5.632	978	9.313
Osmaneli	128.409	48.316	8.301	30.170	41.622
Pazaryeri	97.015	66.036	25.916	3.116	1.947
Söğüt	85.107	50.622	18.091	8.328	8.066
Yenipazar	89.358	73.896	4.257	736	10.469
Total	828.665	523.915	123.302	67.606	113.842

Source: TUIK (Turkish Institute of Statistics) and İVA Statistics 2015

Table 8: *Distribution of Eskişehir Greenhouse Production as per Districts*

Districts	Plastic Greenhouse (da)	High Tunnel (da)
Günyüzü	2	-
Tepebaşı	175	74
Sarıcakaya	1018	243
Mihalgazi	1120	290
Total	2315	607

Source: 2015, TÜİK

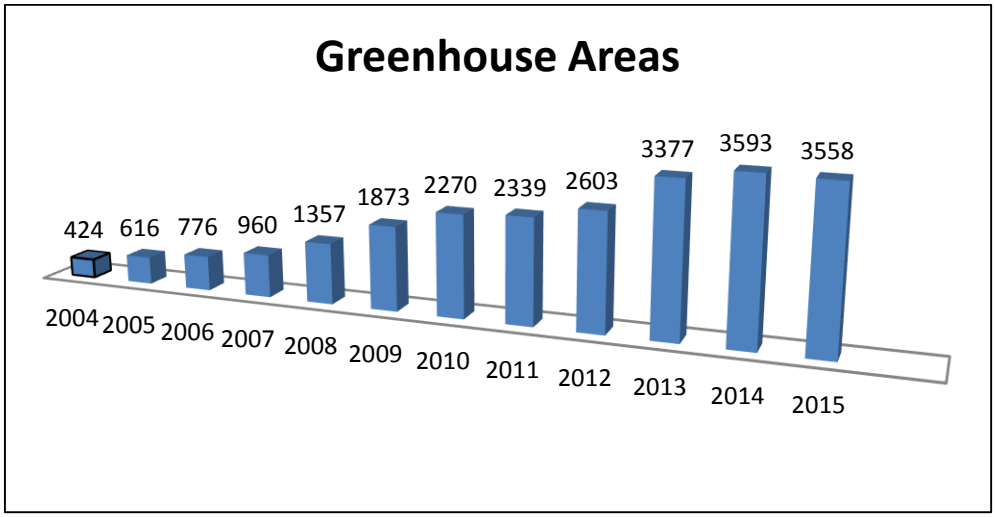

Figure 2: *Year-based Green-House Agricultural Area (da) Rise in Bilecik*

line with the ecological conditions, greenhouse production in Turkey is particularly widespread in the Mediterranean and Aegean coastline [8]. In the continuously developing world, greenhouse is quite a salient agricultural activity that must also be analyzed in view of environmental dimension. Turkey has a greenhouse area larger than 600 thousand decare (Table 4). According to data procured from Provincial Directorate of Food, Agriculture and Livestock year- 2013 greenhouse production in Bilecik is above 3377 decare. We estimate that once the other greenhouse types are also used the ration of greenhouse production areas will increase rapidly.

Bearing in mind that greenhouses are among the top agricultural activities utilizing chemicals, the environmental significance of greenhouse business becomes more evident. Insensible greenhouse activities, applied drugs and chemical fertilizers trigger huge amounts of soil pollution; thereby leading to water pollution [7]. Although it is suggested that this adverse impact could be minimized by educating the farmers, currently, the use of chemicals is still at alarming levels.

3.3 The Status and Development of Greenhouse Business in Bilecik

In simple greenhouse businesses within Bilecik, there is no climate control. The measures are generically geared towards freezing protection.

As we explore district-based distribution of businesses in 2011, we can detect that these ratios reach maximum values in Söğüt and Osmaneli districts. In Söğüt district specifically, production ratio constitutes a considerable portion of the total production area in overall Bilecik. (Table 5).

In Table 6 we can witness year-2012 figures of greenhouse areas in Bilecik in comparison to the total size of cultivated agricultural areas. The same table also reveals that in Bilecik, vegetable production area equates to 81 thousand decares. Since vegetable areas are potential greenhouse production areas it is apparent that in Bilecik, there is a considerably high potential for greenhouse production (Table 7).

As exhibited in Figure 2, for the recent 12 years, greenhouse areas in Bilecik multiplied more than 8 times and 424 decares green-house area in 2004 jumped to 3600 decares in 2016. These data reveal that Bilecik city has a bright future for greenhouse production and the data from the last three years its potential will rise as years pass by. Below is a list of the causes explaining the rise and factors that promote greenhouse business in Bilecik case;

- Macro profit from any micro area,
- Interest toward forced crops,
- Attractive prices that lead to assemblage,
- Incentives and profits,
- Divided and shrunk lands due to inheritance disputes,
- Being a novel business field,
- Maximum product quality.

These factors rendered attraction to greenhouse business.

Also in extensions of Sakarya basin such as Sarıcakaya and Mihalgazi districts that are within the terrains of Eskişehir city, there are certain microclimatic zones favorable for greenhouse production (Table 8). In these districts that normally bear the traces of continental climate of Central Anatolia region, it is still feasible to perform greenhouse production in an area of 1800 decares.

3.4 Problems witnessed in Bilecik Green-house Production:

It is feasible to list the widespread problems experienced in green-house production such; large-size enterprises, materials utilized as construction and cover goods, heating, production material, soil irrigation, plant diseases and pests and challenges faced in marketing process of the produced crops.

As we analyze business structuring and size of Turkey's greenhouse establishments we can detect that greenhouses are mostly founded as small-size family companies. In Turkey, within at least 55% of glass and plastic greenhouses, greenhouse size varies between 1000 m2 to 3000 m2. Technology use is quite limited since these are small-scale enterprises.

In parallel with the same reason, it becomes infeasible to employ any agriculture-trained personnel in the company, thereby traditional greenhouse practices inoculated from father to son or copied from neighbors are continued [6].

Although the claim above was restricted with cities of Antalya, Mersin, Adana, Yalova during the times when greenhouse production newly started, currently the same claims holds true for regions such as Bilecik where greenhouse production is premature.

Findings above attained by Sevgican et al. to unveil greenhouse sizes and business operations in Turkey match with the current status of Bilecik.

As we probe into construction and cover materials it is simply not feasible to allege that all structural problems in our greenhouses have yet been solved; nonetheless it is refreshing to spot certain establishments aiming to solve this conflict and modern greenhouse facilities that are operational. By promoting the use of ready-assembled galvanized construction materials to construct novel greenhouses, Turkey's greenhouses could be shaped to reflect a more contemporary image [6]. Even though the disposition to transmit from high tunnel to greenhouse is significantly lower in Bilecik, İnhisar Municipality, with its four sample modern greenhouse facilities, sets a model for the current modern greenhouse trend.

In green-house production operations within Turkey it is attempted to spend minimum money via exponentially benefiting from current climate conditions for heating purposes. Hence, as for heating, interior space plants are generically grown to eliminate the loss due to freezing in all greenhouses; except indoor ones. Consequentially the yield ratio as well as quality are compromised and plant-disease control becomes much harder. It has been reported that Turkey is located in Alp-Himalianorogenic zone that is a vital geothermal energy region and listed in the top seven countries in terms of geothermal resources [4]. Areas with high-temperature geothermal fluids are positioned in the west of Turkey; areas with low and medium levels of temperature are positioned in the central, eastern and northern directions [4]. It is thus safe to claim that using geothermal resources would ultimately climb Turkey's greenhouse business to expected levels [1]. Sakarya Valley is acknowledged to host geothermal resources in Çaltı Uyuzhamam, Akçasu, Koyunluköy, and Mihalgazi villages. State funds are crucially essential to develop geothermal-heated greenhouse plants in these micro regions and to kick off trailblazer initiations.

In Turkey the number of companies growing vegetable saplings has unprecedentedly risen for the last years, which indeed is quite a noteworthy progress for Turkish greenhouse vegetable production. As known, it is a serious challenge for producers to provide the essential favorable conditions in sapling production. The entire set of seeds used in vegetable types such as tomatoes, cucumbers, lettuce grown in Bilecik high tunnels belongs to F1 hybrid. Although it is still common to use seeds for standard-types in pepper plantation, F1 hybrid use is still on the rapid increase. Seed demand is met by private companies and the majority of planted seeds are imported. In Bilecik, a heightened interest towards grafted sapling emerged due to farmer-soil stemmed problems. The single disadvantage of grafted sapling stems from its high cost. Plantation dates of the most common three vegetables in Bilecik are as exhibited in Table 9.

Table 9: *General Dates of Sapling Planting in Bilecik*

Product name	**Plantation date**
Tomatoes	15 March-15 April
Cucumber	1 April-30 April
Lettuce	1November-1 February

Source: Ministry of Food, Agriculture and Livestock

In Bilecik greenhouses production is still practiced in simple mode under the soil. Nonetheless monoculture practiced in greenhouses and covered soil bring along the problems outlined below:

- Soil exhaustion,
- Soil-borne diseases,
- Nematodes,
- Heightened salt levels in soil,
- Formation of impermeable layer, also known as driving base.

In greenhouse business in Bilecik the most significant soil-related problem is soil-borne diseases and nematodes; hence soil disinfection in

greenhouse business emerges as a first priority application.

In plant growing within a greenhouse, water, which is vital for plant growth is solely met via irrigation unlike open-area plant growing. Thus irrigation practices gain even further importance in greenhouse structures which essentially seek to gain maximum yield in a minimum area and require huge investments to operate fully.

Presently there exist a long list of monitoring methods based on soil, plants and climate to program the irrigation procedures; however, in almost the entire set of Bilecik greenhouses, applied scientific methods are far from matching with desired levels and pH & EC values are simply ignored.

Production in Bilecik is performed in extremely simple facilities bearing unfavorable inner- greenhouse climate conditions – low temperature and high relative humidity in particular– thereby speeding the emergence of fungal and bacterial diseases leading to great losses in plastic greenhouses and tunnels. To take measures against viral, fungal and bacterial diseases highly-resistant hybrid vegetable saplings are selected. In Bilecik greenhouses, the most common pests causing the heaviest financial loss are; white flies (Trialeurodesvaporariorum, Bemiciatabaci), red spiders (Tetranychusurticae, T. cinnabarinus), aphids (Macrosiphumeuphorbiae, Myzuspersicae, Aphisgossypii), leaf miners (Liriomyzaspp.), tomato russet mite (Aculops lycopersici) and tomato leaf miner (Lepidoptera: Gelechiidae) Tuta absoluta. In the fight against diseases and pests, the most widely selected approach is chemical fight. Even though our total consumption level is way below the developed countries it is poignant to say that the levels of pesticides used in our greenhouses are alarmingly high.

As we explore the marketing process of crops grown in Bilecik, the crop with maximum profit rises as tomato. That stems from the fact that tomatoes are heavily consumed, preserved and utilized in food sector. In parallel with the recent developments in greenhouse business tomato exportation also increased and became the most profitable product. In green-house production within Bilecik city tomatoes, cucumbers and lettuce are secondary favorite crops.

In Bilecik there is a void of organized union to fixate producers' marketing styles and reach to an agreed price policy. The involved channels have been listed as Producer-Commissioner-Retailer-Consumer. There have consequentially been price increases. As regards exportation; classification, packaging, and shipping were ignored but for the last few years a heightened interest toward these issues has been witnessed. Due to the gaps in this system, heavy losses in products and values are experienced in domestic as well as foreign market. It would be hugely beneficial to enforce audits to check these matters. In small companies operated by families technology use is limited, which ultimately triggers certain problems. To illustrate a few; there is low level of crop yield and high level of environmental pollution. Since inputs are largely dependent on foreign market, producers should be advised to choose the period whenever costs are minimized and harvested crops bring the highest market price.

4. Conclusion and Suggestions

A large portion of the areas currently utilized for vegetable production are recognized to be potential green-house production fields. In addition, use of thermal resources in heating our green-house facilities could escalate the size of greenhouse areas.

In green-house production practiced within Bilecik the root cause of the ubiquitous problems can be linked to low education level of producers and lack of young employees in agriculture sector. It is suggested to train young generation on certain suggestions to solve these problems and present them the supported case studies that can offer positive results. Hence it would be feasible to motivate the participation of youth to agricultural production thereby taking the major step to solving widespread problems.

As for Bilecik case, Yüksel & Yüksel (2011) in their study attested that current greenhouse business should be further developed and sustained; and to prevent producers' loss certain measures should be taken to boost production profits. Below are the suggested approaches to achieve these objectives;

1. In terms of structuring techniques; in the event that greenhouses are supported by a concrete foundation their resistance level would increase and protect the greenhouses against destructive winds.

2. In the event that ventilation openings are mounted on both sides of greenhouse it would be feasible to ventilate for a short time during windy weather and cold days.
3. Due to the smallness of production areas a greenhouse is allotted to 2-3 producers in every single settlement. That leads to marketing problems and heightened marketing costs. To overcome this problem there is the demand for a system in which producers could act cooperatively. With this system or a union organization, producers could not only effectively utilize their crops but also collect the fruits of their hard labor.
4. It is also suggested that since this is the first time a majority of producers experimented green-house production and most lack adequate technical knowledge on this field, producers should be assisted with more frequent technical support. It is advised to update the producers through seminars or events to disseminate latest insights on plant seeds, saplings, disinfection, ventilation, agricultural pest control, fertilization, irrigation, suspension etc. Further to that the theoretical information should be put into practice in person.
5. Via computing hot-water flows of current thermal resources in greenhouse business regions, they should be utilized as a thermal resource for green-house production. By circulating constantly flowing hot water from thermal resources inside, favorable tubes in the green-house structure could be fixed to the desired temperature level.

Provided that above-listed suggestions are abided by and listed problems are resolved it is deemed to bring along potentially profitable results for the producer and the consumer alike. Producers' income would rise and consumers would be able to purchase fresh vegetables in a more favorable period with lower costs. Hence in Bilecik it is projected to enable a continuous green-house production that is cost-effective for the producers.

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